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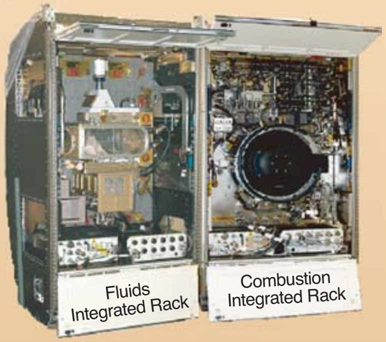
Fluids and Combustion Facility



Fluids and Combustion Facility

The Fluids and Combustion Facility (FCF) is an International Space Station (ISS) research facility designed to support physical and biological experiments in support of technology development and validation in space. The FCF consists of two modular, reconfigurable racks called the Combustion Integrated Rack (CIR) and the Fluids Integrated Rack (FIR). The capabilities of the CIR and FIR as well as the plans for their utilization will support NASA's Vision for Space Exploration. FIR and CIR are planned to be launched on ULF–2, which is currently scheduled for May of 2007. The FCF is being developed at NASA's Glenn Research Center (GRC) in Cleveland, Ohio, under a prime contract with ZIN Technologies. Once on-orbit, both the CIR and the FIR will be operated remotely from the Telescience Support Center at GRC.

FIR

The FIR will accommodate experiments that address critical research and technology needs for advanced life support (i.e., air revitalization, water reclamation, etc.), power, propulsion, and spacecraft thermal control systems. The primary focus of the experiments will involve boiling heat transfer, multiphase flow, liquid vapor interface control, and liquid and vapor evaporation and condensation, as they relate to the technology needs of various exploration spacecraft subsystems. The first planned FIR payload is the Constrained Vapor Bubble (CVB) experiment, which will utilize the Light Microscopy Module (LMM).

The FIR provides a large, contiguous volume for experimental hardware, easily reconfigurable diagnostics (cameras and light sources), customizable software, active rack-level vibration isolation, data acquisition and management, and various other subsystems that will support a wide range of uses. It can also serve as a platform for experiments that address human health and performance, medical technologies, and biosciences.

The LMM is an automated, fully motorized, subrack minifacility based on the Leica RXA microscope. In addition to the CVB experiment, the LMM is capable of supporting biological investigations to identify spacecraft contaminants and performing microscopic observations of materials.

The CVB experiment will provide an understanding of two-phase heat transfer systems controlled by interfacial phenomena under microgravity conditions. Results of this study will be applicable to the development of wickless heat pipe heat exchanger technology that can be utilized in the spacecraft. Wickless heat pipes provide for a more reliable heat exchanger because there are no moving parts. They can utilize a hexagon cross section to reduce the packing factor and volume. The overall mass is reduced due to the elimination of the wick and the smaller volume and increased efficiency of the heat exchanger. Reducing system mass will reduce the cost of space exploration and better enable the spacecraft to reach far off destinations such as Mars.

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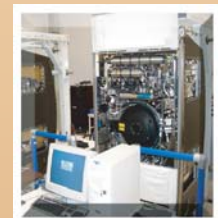
CIR

The CIR provides a 100-liter combustion chamber for experimental hardware, fluid/oxidizer management assembly to condition gases for the experiments, easily reconfigurable diagnostics (digital cameras and light sources), customizable software, passive rack-level vibration isolation, data acquisition and management, and various other subsystems that will support a wide range of uses. It will serve as a platform for fire prevention, detection, and suppression experiments. Also, the CIR has the capability to accommodate a wide variety of additional experiments, such as incineration of solid wastes, power generation, flame spread, and materials synthesis.

Initial experiments performed in the CIR will provide data to support design decisions for exploration spacecraft. The first experiment to be performed in the CIR is the Droplet Flame Extinguishment in Microgravity experiment (FLEX), which uses the Multiuser Droplet Combustion Apparatus (MDCA). This experiment will utilize the spherically symmetric geometry of burning fuel droplets as a model environment for determining the effectiveness of gaseous fire suppressants in microgravity.



The MDCA is the subrack payload, which contains the payload hardware and software necessary for conducting the FLEX experiment. It consists of two major components: a chamber insert assembly and an avionics package. The chamber insert assembly is a framework for mounting the internal components such as the droplet dispensing and deployment mechanisms and radiometers. It is mounted on guide rails in the CIR combustion chamber. The avionics package provides for the command, control, and data handling of the experiment.

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B–1208 Dec 05

Fluids Integrated Rack Assembly and Testing Milestones

Fluids Integrated Rack Assembly and Testing Milestones

December 2003—Rack level assembly begins

June 2004—Rack begins system level testing

August 2004—Astronaut Robert Curbeam performs human factors testing

November 2004—Integrated testing with LMM

December 2004—Rack completes electromagnetic interference testing

January 2005—Rack completes acoustic emissions testing

March 2005—Rack completes mission sequence testing

May 2005—Rack completes modal survey testing

November 2005—Rack completes off-gas testing

May 2003—Receipt of combustion chamber and optics bench

August 2003—Wiring of optics bench

January 2004—Combustion chamber integrated with optics bench

June 2004—Experiment assembly is integrated with the rack

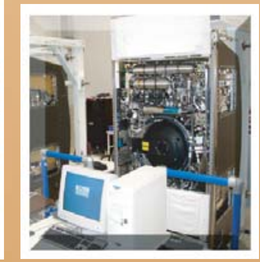
July 2004—Astronaut Robert Curbeam performs human factors testing

October 2004—Populated CIR optics bench for integrated CIR–MDCA testing

February 2005—Rack completes electromagnetic interference testing

June 2005—Rack completes acoustics emission testing

November 2005—CIR and MDCA complete mission sequence testing



Combustion Integrated Rack Assembly and Testing Milestones

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